

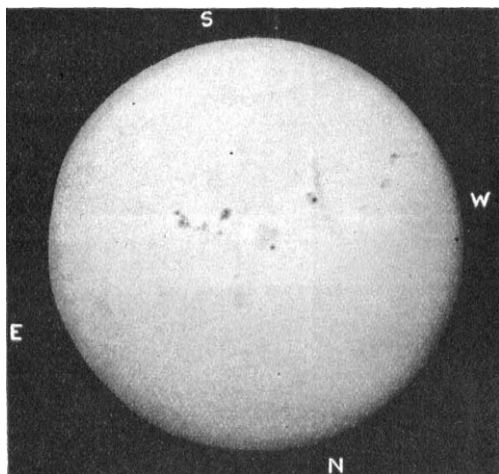
this will focus the image on to the slit of the 30-foot spectroheliograph or that of the Littrow spectrograph; both these instruments will be underground, and will therefore be preserved at a fairly even temperature.

To prevent its distortion, each mirror is to be 12 inches thick, and will be silvered on both sides, and, if necessary, heated on the back by reflected or direct sunlight. An electric motor will drive the photographic plate across the secondary slit of the spectroheliograph, and will by means of a vertical shaft impart a synchronous motion to the 12-inch lens, and hence to the sun's image.

The Littrow spectrograph is to be fitted with an 8-inch plane grating, and will be employed in the study of the solar rotation and in the photography of sun-spot spectra.

**THE RECENT LARGE GROUP OF SUN-SPOTS.**—Another large group of sun-spots visible to the naked eye—of which the solar maximum through which we have just passed has furnished an abnormal number—was observed during the former half of the present month.

The first signs of this group appeared on February 6, when two small nuclei were seen on the eastern limb about  $15^{\circ}$  south of the equator, and these were followed by two similar spots on February 8. On February 9 a larger spot brought up the rear of the group, which then contained a large number of small umbræ. In London,



Photograph of sun taken ch. 47m. February 11, 1907.

bad weather prevented the daily observation of the development of the group, but on February 11 it was easily visible to the naked eye, and was seen to have developed a second fairly large spot at its preceding extremity. The accompanying reproduction is from a photograph taken at oh. 47m. on that date, and it may be seen that the preceding spot was then the largest in the group, and had a peculiar kidney-like shape. The total affected area was then roughly rectangular, with a length of about 115,000 miles and a breadth of about 55,000 miles. Naked-eye observations of two groups were possible on February 14. The larger group formed a striking spectacle on the western limb on February 18, but had disappeared from view when the sun was observed on the following day.

**THE SPECTROSCOPIC BINARY  $\lambda$  ANDROMEDÆ.**—From a number of spectrograms of  $\lambda$  Andromedæ, taken with the Mills spectrograph, 1897-8-9, a set of elements for the orbit of the binary has been computed by Mr. Burns, of the Lick Observatory. On comparing these elements with those determined from more recent spectrograms, taken with the re-mounted Mills spectrograph, it is seen that there are material differences which can only be reasonably accounted for by the supposition that the orbit itself has been modified. The discrepancy, if established, will probably be found to be due to a third body in the system of this star (Lick Observatory Bulletin, No. 105).

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# THE GROWTH OF MICRO-ORGANISMS.<sup>1</sup>

THE author, early in the past year, began to make experiments on the origin-of-life question, with various saline solutions containing ammoniacal salts. After a time he found the best results were to be obtained with one or other of two solutions, one of which contained small quantities of sodium silicate, ammonium phosphate, and dilute phosphoric acid in distilled water, and the other a simple solution of sodium silicate with liquor ferri pernitrat in distilled water. It was found, also, that with the use of these saline solutions exposure of the experimental vessels to diffuse daylight, with even a mean temperature of only  $60^{\circ}$  F. to  $65^{\circ}$  F., favoured the appearance of microorganisms quite as much as, or even more than, darkness associated with an incubator temperature of  $95^{\circ}$  F.

The solutions were placed in previously superheated tubes, which, after being hermetically sealed, were heated again in a calcium chloride bath to  $230^{\circ}$  F. ( $115^{\circ}$  C.),  $248^{\circ}$  F.,  $257^{\circ}$  F., or  $266^{\circ}$  F. ( $130^{\circ}$  C.), for ten to twenty minutes. In all these tubes, after the process of heating, a small deposit, either of silica alone or of silicate of iron, was thrown down. The tubes were subsequently exposed either to diffuse daylight or else in the incubator, and mostly for periods varying from five weeks to four months. When opened, the tubes were found to contain, in varying abundance, one or more kinds of microorganisms, photographs of which were shown.

One point of much interest in connection with these experiments is the fact that no carbon was ostensibly contained in the solutions, though its close chemical ally, silicon, was always present.

It had previously been determined that such solutions proved excellent nourishing media for the growth of microorganisms, and this fact led to trials whether any evidence was to be obtained tending to show that such solutions could also actually engender living units. On examination of the contents of the tubes after their prolonged periods of exposure to light or in the incubator, the organisms were always found, after careful search, on or within the substance of the flakes of silica, while the fluid above remained perfectly clear.

Many organic compounds have been discovered by chemists in which silicon wholly or in part replaces carbon, and it is contended that there is good *prima facie* evidence from these experiments tending to show that silicon is capable of entering into the composition of protoplasm itself—that is, wholly or in part taking the place of carbon.

In regard to the major question, concerning the origin of life itself, the facts to be borne in mind are these:—If a few hours after the heating of the tubes one or more of them be opened as “control” experiments and the sediment carefully examined, no organisms of any kind are to be found, but, after suitable periods of exposure, organisms may be found, in more or less abundance, in the sediment taken from other similar tubes. Here, then, is evidence that *the organisms are living*; they have appeared and multiplied within sealed tubes, though at earlier dates none is to be found.

Then again, it is important to bear in mind (1) that, apart from “spores” of bacilli, no microorganisms can resist an exposure of two or three minutes in boiling water, this being lethal for bacteria, vibrios, micrococci, torulæ, and moulds; and (2) that all ordinary spores of bacilli are killed by a similar exposure for a minute or two to  $115^{\circ}$  C. ( $239^{\circ}$  F.).

It is concluded, therefore, that the bacteria, bacilli, vibrios, micrococci, torulæ, and moulds which have been taken from hermetically-sealed tubes previously heated to  $115^{\circ}$  C.,  $120^{\circ}$  C.,  $125^{\circ}$  C., and  $130^{\circ}$  C. for ten to twenty minutes must have been engendered *de novo* within these vessels.

The organisms that arise *de novo* are presumed by the author to assume well-known forms, for precisely the same reason that the various representatives of the crystalline world, *when they originate*, invariably fall into their own specific shapes, and with surfaces always inclined to one

<sup>1</sup> “On the de-novo Origin of Bacteria, Bacilli, Vibrios, Micrococci, Torulæ and Moulds in certain previously superheated Saline Solutions contained within hermetically sealed Tubes.” By Dr. H. Charlton Bastian, F.R.S. Read before the Royal Medical and Chirurgical Society on January 22.

